CALIBRATION DEVICE

[0001] The invention relates to a calibration device according to the preamble of claim 1.

[0002] Calibration devices are used, for example, for calibrating extruded continuous profiles, in particular tubes. Plastic melt is hereby initially prepared in an extruder and shaped by an exit nozzle. To assure the desired dimensioning of the continuous profile, the latter travels through the calibration device after the shaping operation for providing precise size thereof.

[0003] Up to some time ago, the production of plastic tubes required the availability of various calibration devices for different wall thicknesses or outer diameters. Hereby, the tools needed to be replaced, requiring a shutdown of the machine which leads to downtimes.

[0004] DE 198 43 340 C2 thus proposed to use an adjustable calibration device for different tube dimensions. This calibration device includes a plurality of lamellae which are distributed in spaced-apart relationship about the circumference on the outer sides of the tube to be sized. Viewed in production direction of the tube, a plurality of such lamellae rings is disposed within a calibration station, with the individual lamellae of the individual lamellae rings positioned with clearance to thereby permit easy adjustment of the lamellae of the individual rings in relation to the lamellae of the subsequent ring or the preceding ring. The lamellae are united in segments to form a lamellae block and supported by a holding structure. The holding structure in turn is connected to the housing for radial adjustment.

[0005] A problem of this construction of the calibration device is however the single-piece configuration of the holding structure. It has been shown during

production of the calibration device that part of the holding structure, namely the adjustable part, must be first inserted in the housing. Then, the individual lamellae are secured to the support and holding structure in a manner that is difficult to implement.

[0006] It is an object of the present invention, to provide a calibration device which can be made and assembled in a simple manner.

[0007] This object is attained by the features set forth in claim 1.

[0008] The basic idea of the present invention is the construction of the mounting and operating device itself in two parts, whereby a first part of the mounting and operating device may be received in the housing independently from a second part. The second part of the mounting and operating device may serve as part of the support structure or may be connected therewith. This enables the arrangement of the individual lamellae on the support structure outside the housing so that the support structure can then – while the segment blocks are completed as such – be installed in the housing. Both parts of the mounting and operating device are hereby connected to one another.

[0009] This construction has proven advantageous especially in those circumstances when the second part of the mounting and operating device, received in the housing, is configured for radial adjustment of the respective segment blocks and oftentimes is thus incorporated in the housing in a structurally complex manner.

[0010] According to a preferred embodiment, the mounting and operating device is constructed in the form of a spindle drive, wherein – according to an embodiment – a spindle is arranged upon the support structure with an outer thread portion. The outer thread portion interacts with a spindle nut which is

rotatably driven via a further drive element. The spindle is hereby constructed in two parts, with a first part connected to the support structure, and with a second part which includes the outer thread portion.

[0011] The connection of both parts of the mounting and operating device may involve a latch, a screw connection or similar conventional connection mechanisms.

[0012] A particularly simple embodiment is characterized by the construction of the second part of the spindle, received in the housing, substantially in the form of a threaded rod with an outer thread.

[0013] The support structure may include a rod or a bar for successive stringing of individual segments of a segment block. The segments are spaced from one another at predefined distances by spacer sleeves. The first part of the spindle would then be connected with such a rod or bar of the support structure. Preferably, this part may hereby be provided with a bore for passage of the rod or bar. Of course, it is also possible to stabilize the entire device by providing two or more rods or bars for the support structure. As an alternative, the support structure may also be constructed differently.

[0014] A further preferred embodiment of the invention is characterized in that the spindles are each comprised of a spindle mounting and a spindle sleeve. The spindle mounting includes a spindle rod and an adjacent part which is connected to the support structure. The spindle rod is received with precision fit and fixedly securable in the spindle sleeve. In this embodiment, the spindle sleeve having an outer thread could be inserted into the housing without the spindle rod. The individual segment blocks could then be placed in a pertaining spindle sleeve into the housing by inserting the respective spindle rod. Once placed, the respective spindle rods and spindle sleeves are braced with one

another, by a screwed connection for example, so as to realize a securement of spindle mounting and spindle sleeve.

[0015] Securement may be realized for example by providing a thread at the end of the spindle rod in opposition to the support structure, and by threadably engaging a nut on the spindle to secure or clamp the spindle sleeve in relation to the spindle rod.

[0016] Two preferred embodiments of the invention will now be described in greater detail with reference to the attached drawings in which:

[0017] Fig. 1 shows a schematic sectional illustration of an embodiment of a calibration device according to the invention in perpendicular relationship to the production direction of a tube,

[0018] Fig. 2 shows a schematic sectional illustration of a calibration device like in Fig. 1 in parallel relationship to the production direction,

[0019] Fig. 3 shows a schematic simplified illustration of an individual segment block from the calibration device of Figs. 1 and 2,

[0020] Fig. 4 shows two views of a first embodiment of a spindle support for retaining a segment block,

[0021] Fig. 5 shows a further segment block with a further embodiment of a spindle support, and

[0022] Fig. 6 shows a partial frontal view of a segment block.

[0023] A complete arrangement of an apparatus for making a plastic tube can be gathered from DE 198 43 340 C2 which already illustrates an adjustable calibration device. The adjustable calibration device is hereby a core component of a tube extrusion plant with option to change dimensions. It assumes the shaping task of a standard calibration, but may be infinitely adjustable across a diameter range which is predefined based on the construction.

[0024] This adjustment is rendered possible by forming the surface, which bears upon the tube, with a great number of individual segments. The segments 18 illustrated in Fig. 1 are rounded along their circumferential direction of the tube in correspondence with the greatest possible outer tube diameter and are united to single segment rings. These segment rings are arranged in production direction in spaced-apart relationship, positioned however snugly fitted behind one another. Two successive segment rings are combined to a dimension ring and arranged in offset relationship with clearance. This ensures the absence of any edges during passage of the tube through the calibration device. The individual segment surfaces form jointly a substantially smooth inner tube surface with substantially circular geometry.

[0025] The segments 18 positioned axially behind one another in production direction of the tube are united to form a segment block. Used hereby is a support structure 30 as will be described hereinafter in greater detail with reference to Fig. 5. The support structure 30 is connected with a mounting and operating device 20 which connects the respective segment blocks with the housing of the calibration device for radial adjustment. The housing of the calibration device includes according to the exemplary embodiment of Fig. 1 two cylinder portions 12 and 14 arranged coaxially within one another. Received in these cylinder portions in the form of a circle are the individual segment blocks 16. A single segment block 16 of the first embodiment is depicted schematically in Fig. 3.

[0026] It includes lamellae 18 arranged behind one another and secured to two support rods. The support rods form the support structure 30. Disposed on the support rods in turn are two spindle carriers 20 spaced in axial direction from one another. The spindle carriers 20 are shown in two views in Fig. 4 and include an attachment portion 42 which is connected or connectable to the support structure 30, and a threaded rod 40. The threaded rod 40 and the attachment portion 42 are detachably connectable with one another at the connection position, for example by an unillustrated screw connection, clamp connection, latch connection or other connection.

[0027] When the calibration device is completely assembled, the externally threaded rods 40 are received in associated bores of the housing cylinders 12 and 14. Provided for each externally threaded rod is a gear nut 22 between both housing cylinders 12 and 14 for interaction with the outer thread of the externally threaded rod 40 in an adjustable manner.

[0028] Disposed in form of a circle in perpendicular relationship to the production direction of the tube 24 (compare Fig. 1) are 12 segment blocks. Each segment block includes two spindle carriers 20 disposed in axially spaced-apart relationship (Fig. 2) and respectively interacting with a pertaining gear nut 22. The gear nuts 22 in turn are adjusted in unison by a gear ring 26 which extends on the circumference between the axially spaced gear nuts 22. The gear ring 26 includes hereby on both its edges teeth which mesh with the gear nuts 22.

[0029] Actuation of the gear ring 26 enables radially outward or inward adjustment of all segment blocks simultaneously and in a same manner. Radial adjustment of all segment blocks in like manner establishes a variable calibration diameter. Thus, the outer diameter of the tube 24 to be calibrated can be defined within the adjustment range.

[0030] An advantage of the present embodiment is the two-part construction of the mounting and operating device configured in the form of spindle carriers 20. This enables the insertion of the externally threaded rods 40 into the housing 12, 14 and their respective alignment. Parallel thereto, the segment blocks 16 can be established by lining up the individual segments 18 on the support structure 30. The support structure 30 is hereby firmly connected also with the attachment portion 42.

[0031] As a consequence of the connection option between the attachment portion 42, on one hand, and outer thread portion 40, on the other hand, the individual segment blocks 16 can easily be placed into the housing 12, 14 without any problem. In this way, the calibration device can be manufactured in a simple and cost-efficient manner.

[0032] A further embodiment of the invention is illustrated in Figs. 5 and 6 which depict in more detail a segment block 16'. This segment block 16' includes two different lamellae configurations 18' and 18" disposed in alternating relationship. Each lamellae includes two bores and is thus strung on retention rods 52 and 54. The individual lamellae 18' and 18" are hereby separated from one another by spacers. Disposed on the ends of the retention rods 52 and 54 are internal threads so that insertion of a screw enables a bracing of all segments 18' and 18" with one another.

[0033] Received at two axial positions are a lower part of a spindle rod 60 instead of the spacer sleeves. The spindle rod 60 includes two bores through which the retention rods 52 and 54 extend. The spindle rod 40 has the shape of a pin above the attachment portion and terminates at its upper end with an outer thread. Pushed over the spindle rod 60 is a spindle sleeve 62 which has an outer thread at its outer circumference. The spindle sleeve 62 bears with its lower end upon a seat of the spindle rod 60. At the upper end, the spindle sleeve is secured

to the spindle rod 60 through screwed connection of the screw 64 to the outer thread of the spindle rod.

[0034] When a calibration device is assembled in accordance with the second embodiment, the lower part of the segment block 16' can be made while the spindle rod 60 and spindle sleeve 62 are still separate, by pushing the individual lamellae 18' and 18'' onto the respective support rods 52 and 54 using the spacer sleeves, and subsequent threaded engagement to the ends of the retention rods 52 and 54. The two spindle rods 60 are hereby integrated in the support structure 30' in axially-spaced-apart relationship.

[0035] Parallel thereto, the spindle sleeves 62 are inserted in the calibration housing, not shown in greater detail here, and respectively adjusted. Then, the lower parts of the segment blocks 16' are inserted into the respective spindle sleeve 62 through insertion of the spindle rods 60. The segment blocks 16' are then firmly mounted in the housing by tightening the screw 64 and accompanying fixation of the spindle rods and spindle sleeves 62.

[0036] In summary, the present invention ensures a simple and thus cost-efficient assembly of the calibration device.

List of Reference characters

10	calibration basket
12	outer housing cylinder
14	inner housing cylinder
16	lamellae segment block
18, 18', 18''	lamellae
20, 20'	spindle carrier
22	gear nut
24	tube
26	gear ring
30, 30'	lamellae support
40	externally threaded rod
42	attachment part
44	connection position
46	bores
52	lower support rod
54	upper support rod
60	inner spindle rod
62	spindle sleeve
64	bracing screw
66	screws